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(54) **HEAT AND FLAME SHIELD**

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D04H 1/04 (2006.01)
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(52) **U.S. Cl.** **19/302**; 19/145.5; 28/100; 156/62.2

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See application file for complete search history.

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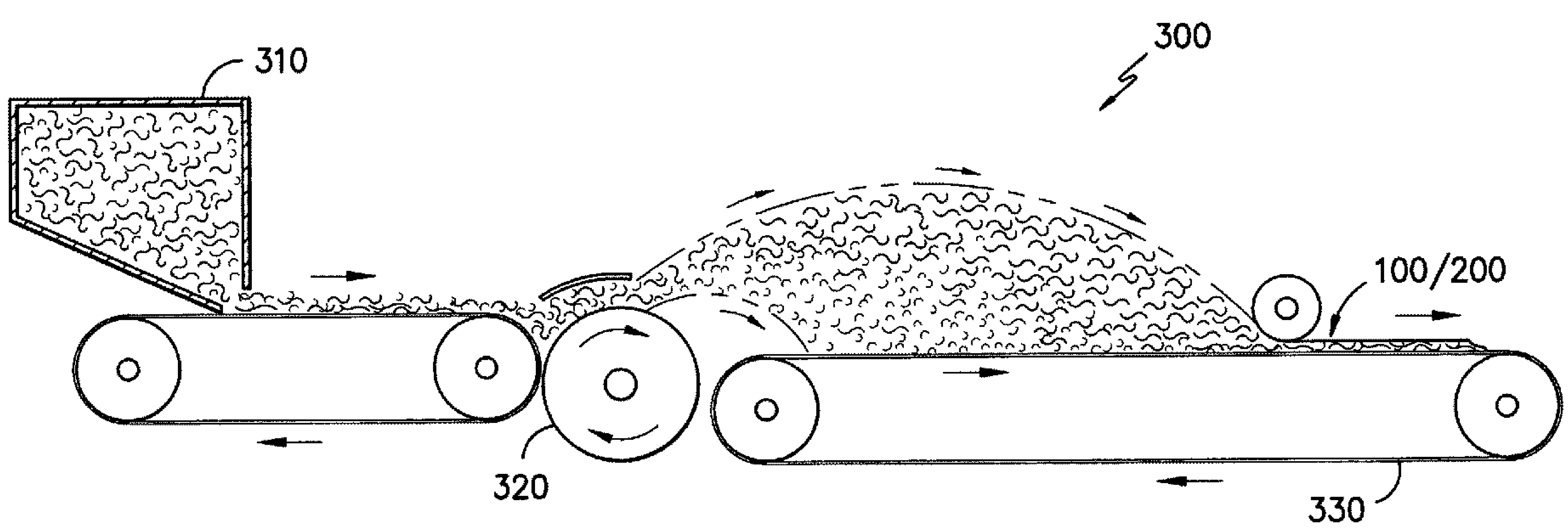
(57) **ABSTRACT**

A heat and fire resistant planar unitary shield formed of heat and flame resistant fibers and voluminous bulking fibers. The shield material has a heat and flame resistant zone with a majority of the heat and flame resistant fibers, and a voluminous bulking zone with a majority of the voluminous bulking fibers. The fibers are distributed through the shield material in an manner that the heat and flame resistant fibers collect closest to the outer surface of the shield with the heat and flame resistant zone, and the voluminous bulking fibers collect closest to the outer surface of the shield material with the voluminous bulking zone.

2 Claims, 5 Drawing Sheets



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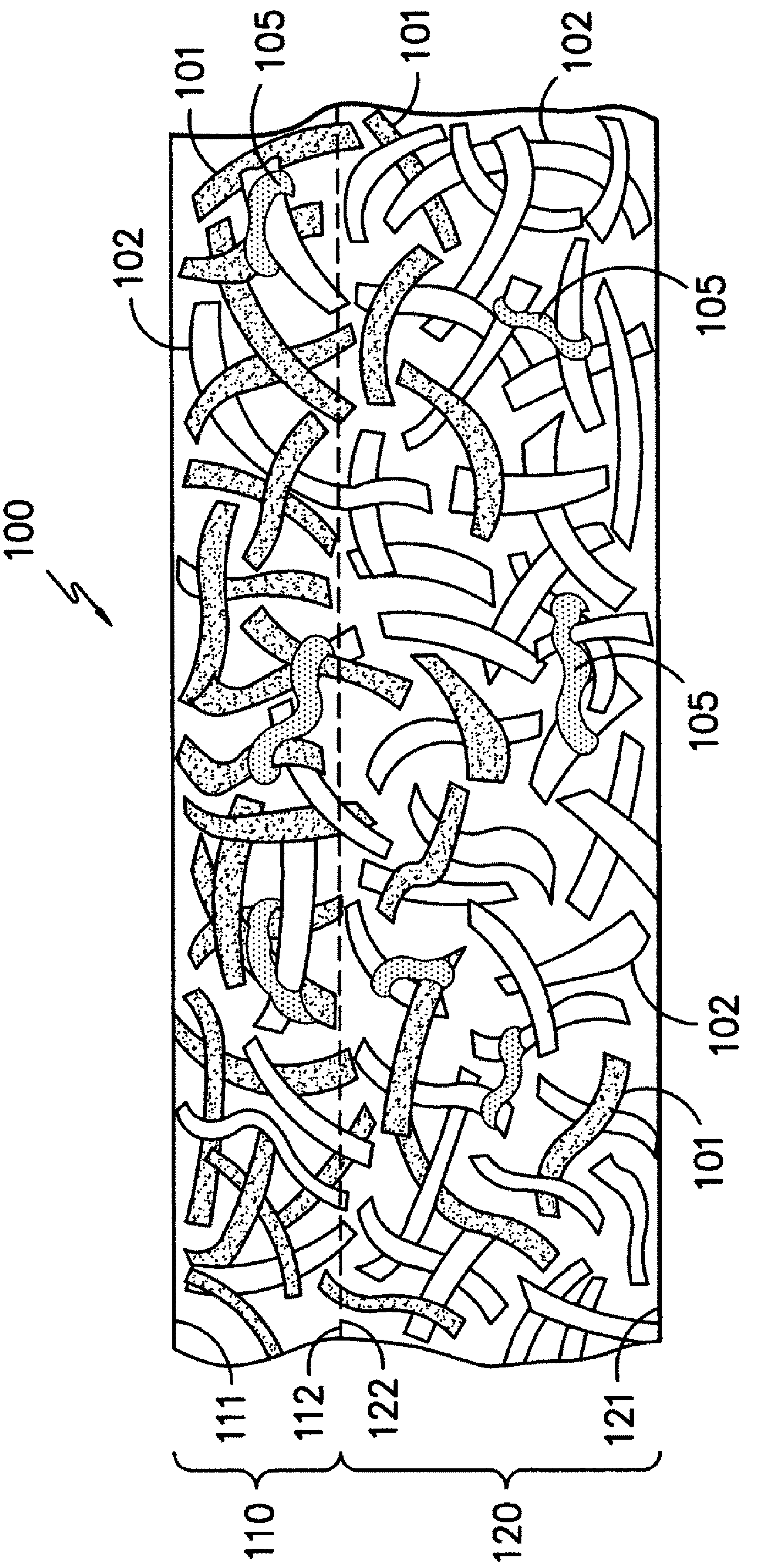

FIG. —1—

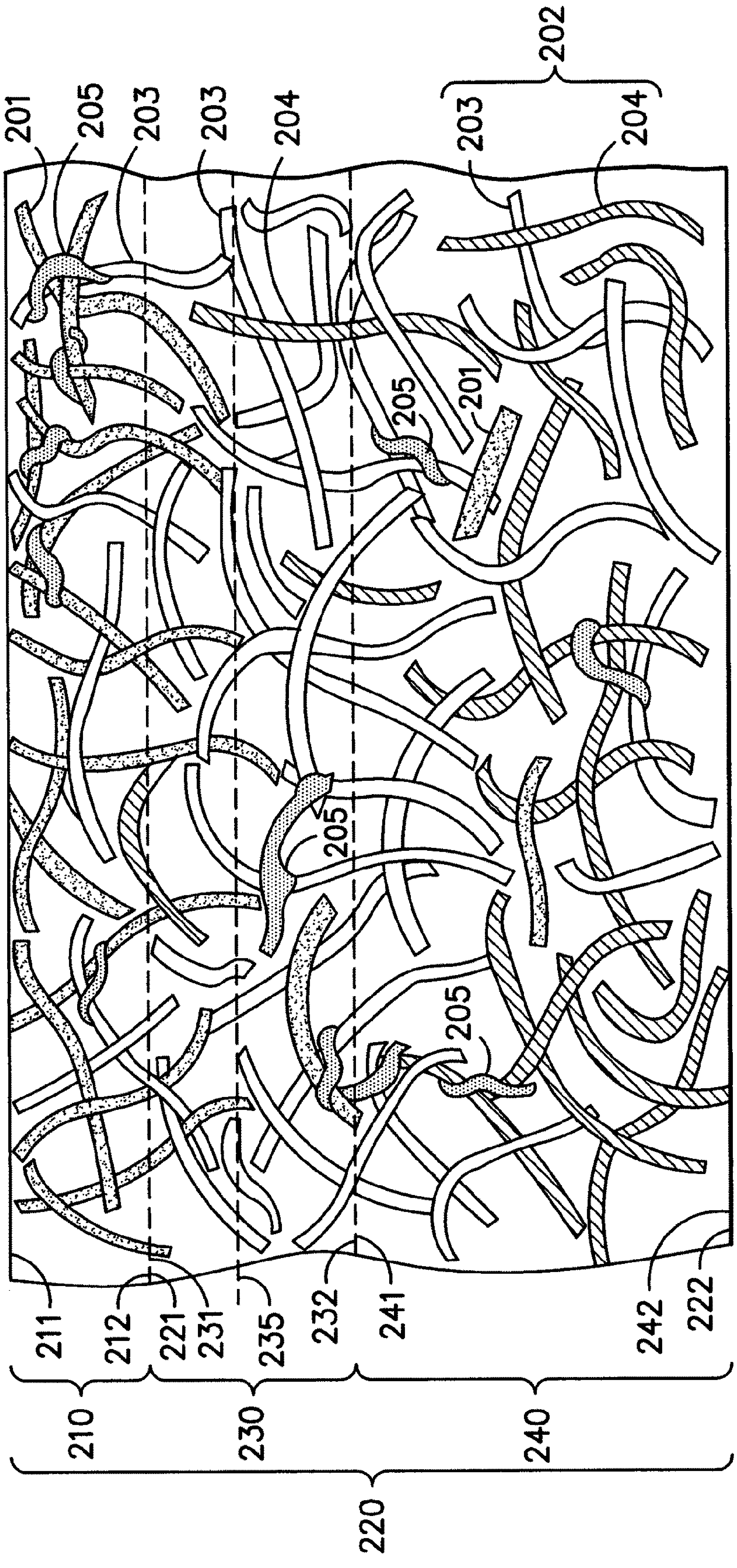
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FIG. -2-

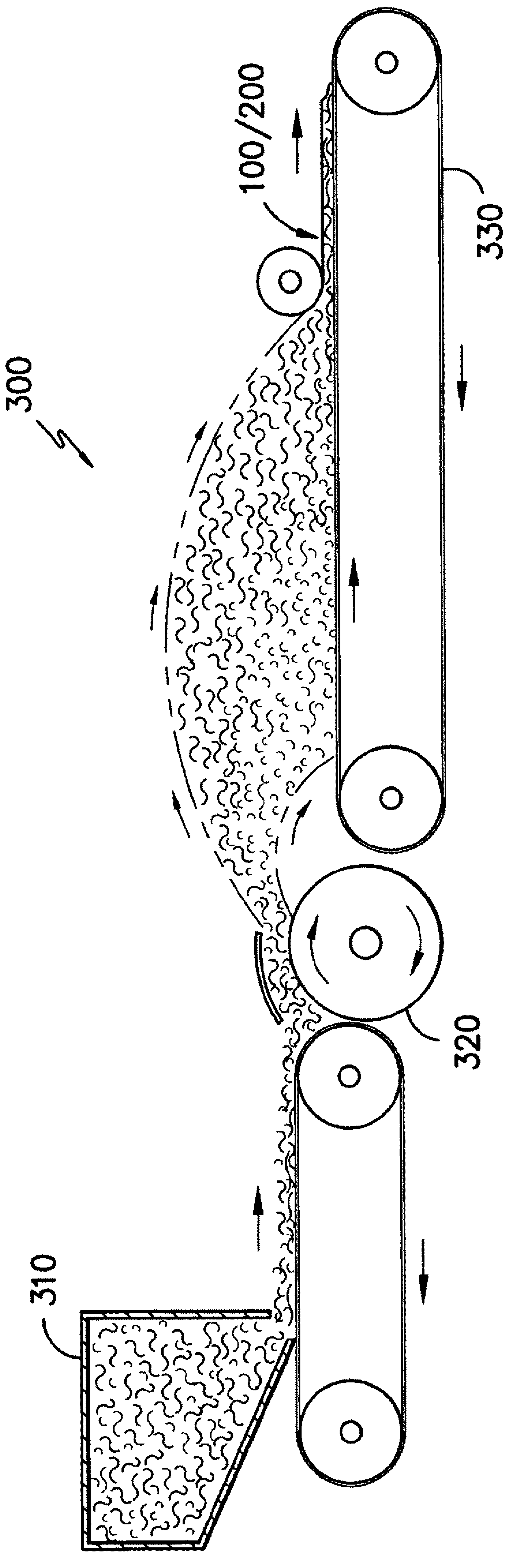

FIG. —3—

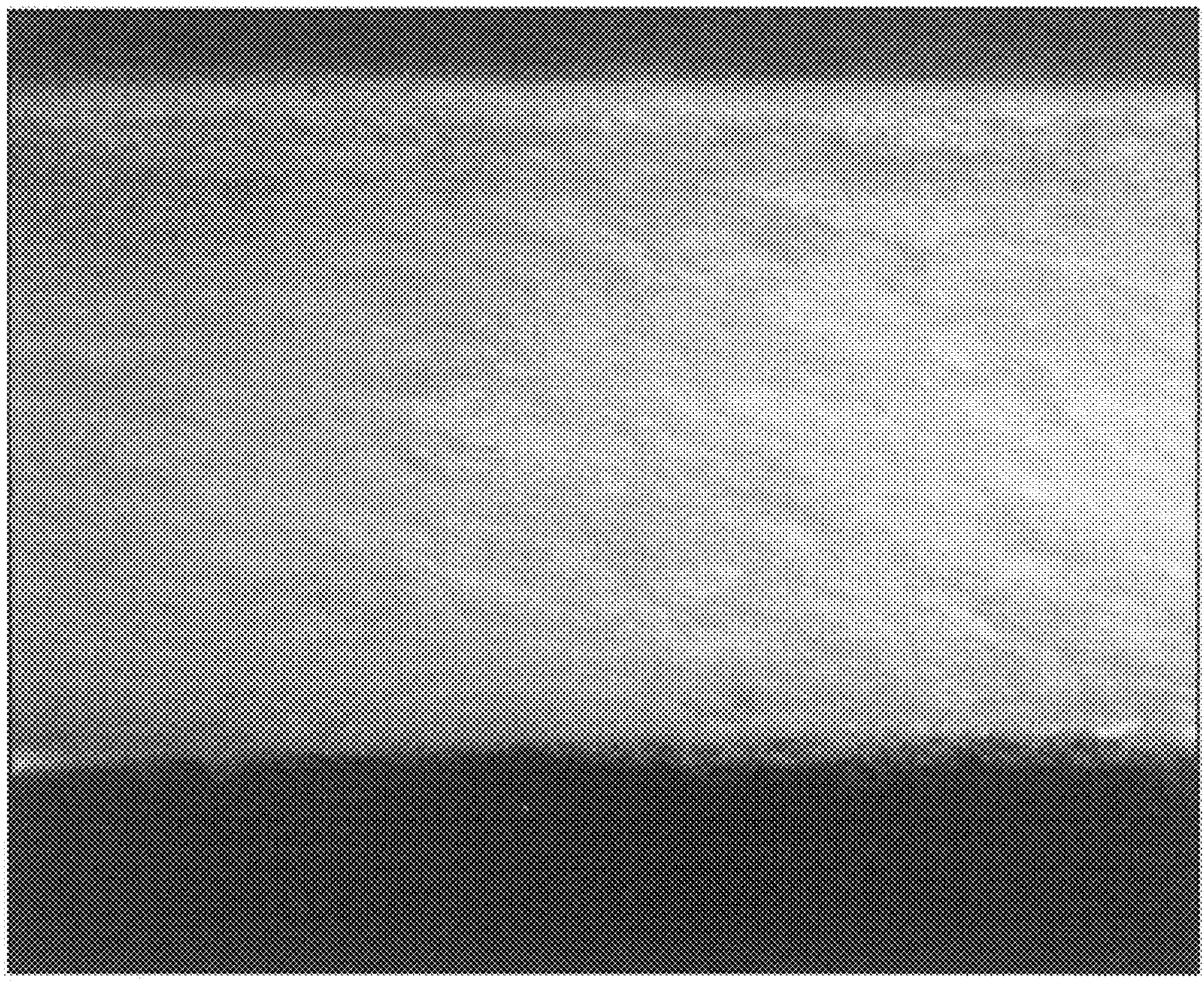

FIG. —4—

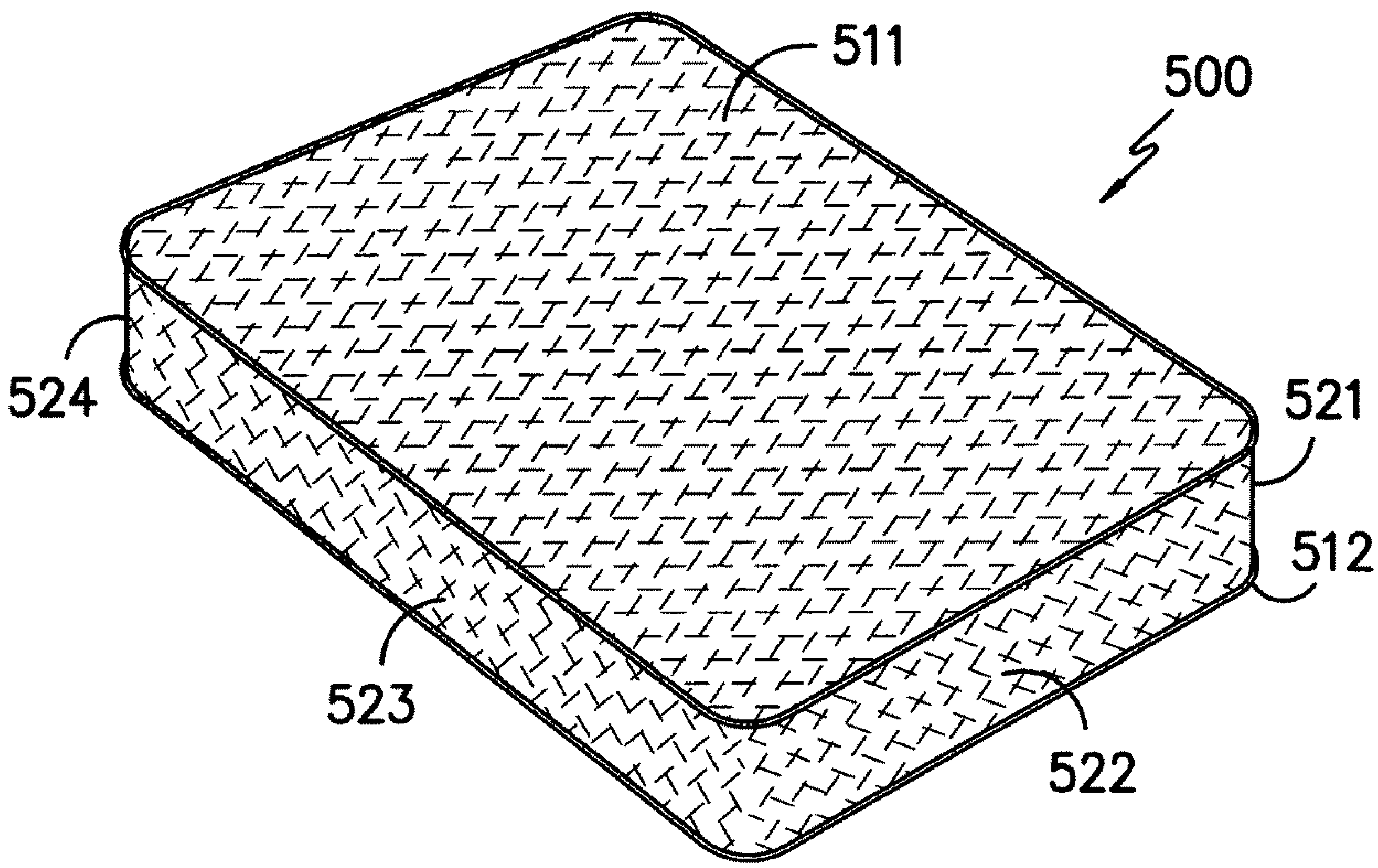

FIG. -5-

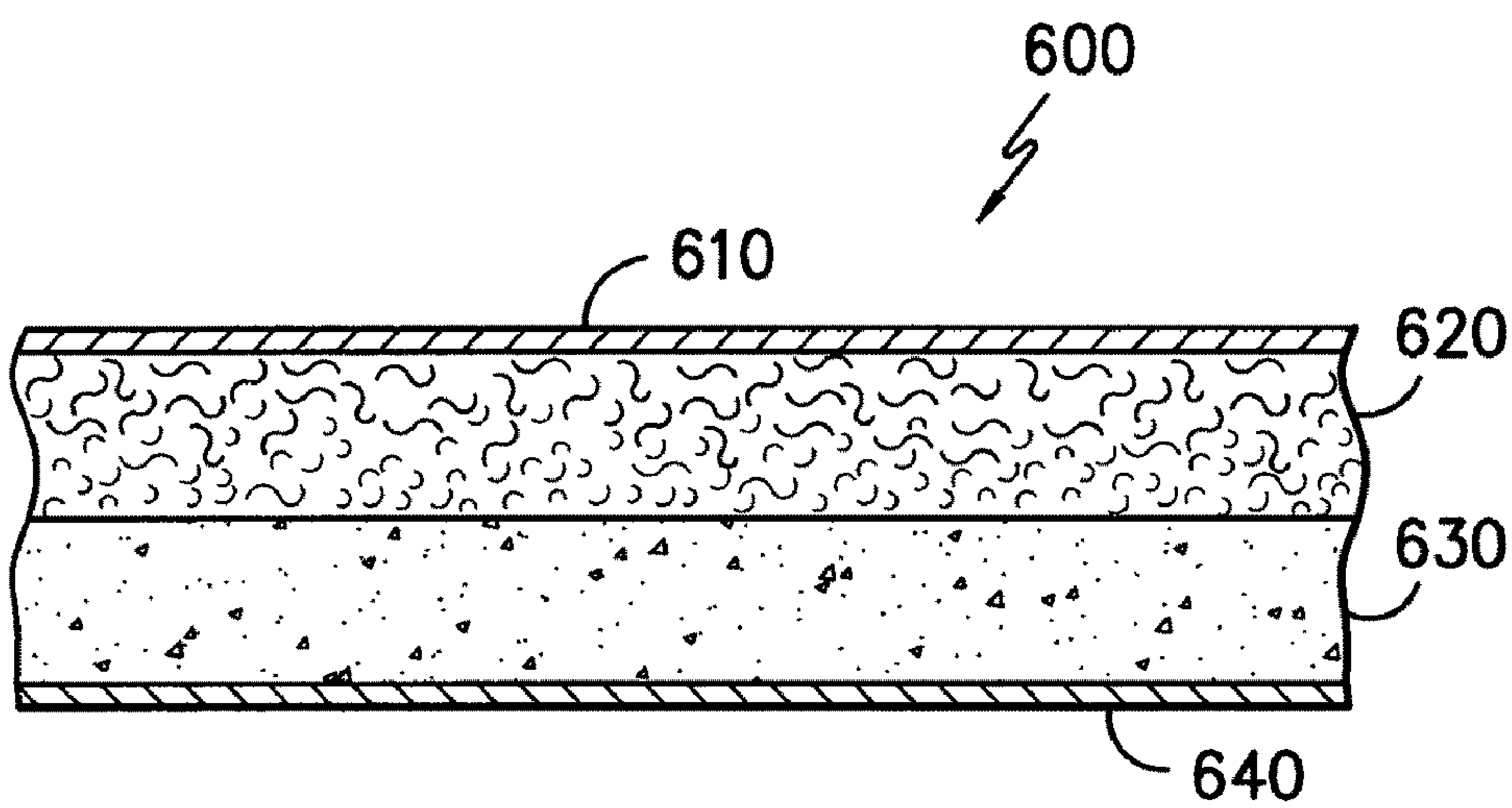

FIG. -6-

HEAT AND FLAME SHIELD

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a divisional of U.S. application Ser. No. 11/123,337 filed on May 6, 2005, now U.S. Pat. No. 7,229, 938 which is a continuation-in-part of prior U.S. application Ser. No. 10/841,148 filed May 7, 2004, now U.S. Pat. No. 7,153,794 the contents of all of which are incorporated by reference herein in their entirety.

BACKGROUND

The present invention generally relates to materials for use in shielding from heat and/or flame, and in particular, heat and/or flame shielding material that can be used in applications such as hood liners for automobiles, engine compartment liners, bedding construction, upholstery, wall padding, and the like.

Numerous industries require materials which not only deliver heat and flame resistant properties, but can also provide volume, opacity, moldability, and other properties in a cost effective single substrate. Often times these barrier properties are best accomplished by using specialty materials which generate a high level of performance, but also introduce significant cost to the substrate. Especially in a voluminous substrate (high z direction thickness) even the introduction of a small percent of these materials into the shield material can introduce a significant level of cost to the overall substrate. For this reason composites having specialty surface layers are often used to provide these barrier properties. An example of a composite having specialty surface layers would be a skin laminated to a voluminous lower cost material. While this method effectively reduces the cost of the high cost raw material, there are disadvantages to this method such as additional processing steps and the potential delamination of the skin layer.

The present invention provides an alternative to the prior art by using a unitary heat shield material with different zones to provide the various desired properties of the material

BRIEF DESCRIPTION OF THE DRAWINGS

These and other features, aspects, and advantages of the present invention will become better understood with regard to the following description, appended claims, and accompanying drawings where:

FIG. **1** shows an enlarged cross-section of one embodiment of the present invention;

FIG. **2** shows an enlarged cross-sectional view of another embodiment of the present invention;

FIG. **3** shows a diagram of a machine for performing a process for forming the planar heat and flame resistant shield material of the present invention;

FIG. **4** shows a magnified cross sectional view of a shield material according to the embodiment in FIG. **1**;

FIG. **5** shows a perspective view of a bed utilizing the shield material of the present invention; and,

FIG. **6** shows an enlarged partial view of the walls from the bed in FIG. **5**, and the shield material incorporated therein.

DETAILED DESCRIPTION

Referring now to the figures, and in particular to FIG. **1**, there is shown an enlarged cross-sectional view of an embodiment of the present invention, illustrated as a planar heat and

flame shield material **100**. The shield material **100** may be used in its existing sheet form as a protective blanket or shield in operations such as welding, high temperature manufacturing, or the like. The shield material **100** may also be formed into parts such as automotive hood liners, engine compartment covers, and the like. Additionally, the shield material **100** can be incorporated with other materials, and/or into a structure to provide the materials and structures with additional heat and flame resistance. For example, the shield material **100** can be incorporated into the outer material of a bed, upholstery, wall padding, and other structures to provide additional flame and heat resistance to those structures. Because of the bulk associated with the shield material **100**, incorporating the shield material **100** into such structures may also provide a cost benefit by replacing any bulking material in the structures.

As illustrated, the planar shield material **100** generally contains heat and flame resistant fibers **101** and bulking fibers **102**. The heat and flame resistant fibers **101** and the bulking fibers **102** are staple fibers that are combined to form the shield material **100**. As used herein, heat and flame resistant fibers shall mean fibers having an Limiting Oxygen Index (LOI) value of 20.95 or greater, as determined by ISO 4589-1. Types of heat and flame resistant fibers include, but are not limited to, fire suppressant fibers and combustion resistant fibers. Fire suppressant fibers are fibers that meet the LOI by consuming in a manner that tends to suppress the heat source. In one method of suppressing a fire, the fire suppressant fiber emits a gaseous product during consumption, such as a halogentated gas. Examples of fiber suppressant fibers includes modacrylic, PVC, fibers with a halogenated topical treatment, and the like. Combustion resistant fibers are fibers that meet the LOI by resisting consumption when exposed to heat. Examples of combustion resistant fibers include silica impregnated rayon such as rayon sold under the mark VISIL®, partially oxidized polyacrylonitrile, polyaramid, para-aramid, carbon, meta-aramid, melamine and the like. Bulking fibers are fibers that provide volume to the heat shield material. Examples of bulking fibers would include fibers with high denier per filament (one denier per filament or larger), high crimp fibers, hollow-fill fibers, and the like.

In one embodiment, the heat and flame resistant fibers **101** and the bulking fibers **102** are air-laid with a binder fiber **105**. Binder fibers are fibers that form some type of adhesion or bond with the other fibers. Binder fibers can include fibers that are heat activated. An additional benefit of using a binder fiber **105** in the shield material **100** that is heat activated, is that the shield material **100** can be subsequently molded to part shapes for use in automotive hood liners, engine compartment covers, etc. Examples of heat activated binder fibers are fibers that can melt at lower temperatures, such as low melt fibers, core and sheath fibers with a lower sheath melting temperature, and the like. In one embodiment, the binder fibers are a polyester core and sheath fiber with a low melt temperature sheath.

Still referring to FIG. **1**, the heat and flame resistant fibers **101** are concentrated in a heat and flame resistant zone **110** of the planar shield material **100**, and the bulking fibers **102** are concentrated in a voluminous bulking zone **120** of the planar shield material **100**. The heat and flame resistant zone **110** provides the shield material **100** with the primary heat and flame resistant attributes. The voluminous bulking zone **120** provides the shield material **100** with the desired z-direction thickness which extends horizontally from the planar dimension of the shield material **100**. In the embodiment illustrated in FIG. **1**, the heat and flame resistant zone **110** is smaller in the z-direction than the voluminous bulking zone **120**.

Referring still to FIG. **1**, the heat and flame resistant zone **110** has an outer boundary **111** located at the outer surface of the shield material **100**, and an inner boundary **112** located adjacent to the voluminous bulking zone **120**. The voluminous bulking zone **120** has an outer boundary **121** located at the outer surface of the shield material **100** and an inner boundary **122** located adjacent to the heat and flame resistant zone **110**. The shield material **100** is a unitary material, and the boundaries of the two zones do not represent the delineation of layers, but areas within the unitary material. Because the shield material **100** is a unitary material, and the heat and flame resistant zone **110** and the voluminous bulking zone **120** are not discrete separate layers joined together, various individual fibers will occur in both the heat and flame resistant zone **110** and the voluminous bulking zone **120**. Although FIG. **1** illustrates the heat and flame resistant zone **110** being a smaller thickness than the voluminous bulking zone **120**, the relative thickness of the two zones can have a substantially different than as shown.

Referring still to FIG. **1**, the heat and flame resistant zone **110** contains both the heat and flame resistant fibers **101** and the bulking fibers **102**. However, the heat and flame resistant zone **110** primarily contains the heat and flame resistant fibers **101**. Additionally, the distribution of the fibers in the heat and flame resistant zone **110** is such that the concentration of the heat and flame resistant fibers **101** is greater at the outer boundary **111** of the heat and flame resistant zone **110** than the inner boundary **112** of that zone. Also, as illustrated, it is preferred that the concentration of the heat and flame resistant fibers **101** decreases in a gradient along the z-axis from the outer boundary **111** of the heat and flame resistant zone **110** to the inner boundary **112** of that zone.

Still referring to FIG. **1**, the voluminous bulking zone **120** contains both the heat and flame resistant fibers **101** and the bulking fibers **102**. However, the voluminous bulking zone **120** primarily contains the bulking fibers **102**. Additionally, the distribution of the fibers in the voluminous bulking zone **120** is such that the concentration of the bulking fibers **102** is greater at the outer boundary **121** of the voluminous bulking zone **120** than the inner boundary **122** of that zone. Also, as illustrated, it is preferred that the concentration of the bulking fibers **102** decreases in a gradient along the z-axis from the outer boundary **121** of the voluminous bulking zone **120** to the inner boundary **122** of that zone.

Referring now to FIG. **2**, there is shown an enlarged cross-sectional view of another embodiment of the present invention, illustrated as a heat and flame shield material **200**. As illustrated, the shield material **200** generally contains heat and flame resistant fibers **201** and bulking fibers **202**. The heat and flame resistant fibers **201** and the bulking fibers **202** are staple fibers that are combined to form the shield material **200**. In one embodiment, the heat and flame resistant fibers **201** and the bulking fibers **202** are air-laid with a binder fiber **205**. When the binder fiber **205** is a heat activated binder fiber, the combination of fibers is heated to activate the binder fiber **205** for bonding together the fibers of the shield material **200**. An additional benefit of using a heat activated binder fiber as the binder fiber **205** in the shield material **200** is that the shield material **200** can be subsequently molded to part shapes for use in automotive hood liners, engine compartment covers, etc.

Still referring to FIG. **2**, the heat and flame resistant fibers **201** are concentrated in a heat and flame resistant zone **210** of the shield material **200**, and the bulking fibers **202** are concentrated in a voluminous bulking zone **220** of the shield material **200**. The heat and flame resistant zone **210** provides the shield material **200** with the primary heat and flame resistant attributes of the shield material **200**. The voluminous bulking zone **220** provides the shield material **200** with the desired z-direction thickness. In the embodiment illustrated in FIG. **2**, the heat and flame resistant zone **210** is smaller in the z-direction than the voluminous bulking zone **220**.

Referring still to FIG. **2**, the heat and flame resistant zone **210** has an outer boundary **211** located at the outer surface of the shield material **200**, and an inner boundary **212** located adjacent to the voluminous bulking zone **220**. The voluminous bulking zone **220** has an outer boundary **221** located at the outer surface of the shield material **200** and an inner boundary **222** located adjacent to the heat and flame resistant zone **210**. The shield material **200** is a unitary material, and the boundaries of the two zones do not represent the delineation of layers, but areas within the unitary material. Because the shield material **200** is a unitary material, and the heat and flame resistant zone **210** and the voluminous bulking zone **220** are not discrete separate layers joined together, various individual fibers will occur in both the heat and flame resistant zone **210** and the voluminous bulking zone **220**. Although FIG. **2** illustrates the heat and flame resistant zone **210** being a smaller thickness than the voluminous bulking zone **220**, the relative thickness of the two zones can have a substantially different than as shown.

Still referring to FIG. **2**, the heat and flame resistant zone **210** contains both the heat and flame resistant fibers **201** and the bulking fibers **202**. However, the heat and flame resistant zone **210** primarily contains the heat and flame resistant fibers **201**. Additionally, the distribution of the fibers in the heat and flame resistant zone **210** is such that the concentration of the heat and flame resistant fibers **201** is greater at the outer boundary **211** of the heat and flame resistant zone **210** than the inner boundary **212** of that zone. Also, as illustrated, it is preferred that the concentration of the heat and flame resistant fibers **201** decreases in a gradient along the z-axis from the outer boundary **211** of the heat and flame resistant zone **210** to the inner boundary **212** of that zone.

Referring still to FIG. **2**, the bulking fibers **202** of the shield material **200** comprise first bulking fibers **203** and second bulking fibers **204**. In one embodiment, the first bulking fibers have a higher denier per filament, and/or mass per fiber, than the heat and flame resistant fibers **201**, and the second bulking fibers **204** have a higher denier per filament, and/or mass per fiber, than the first bulking fiber **203** and the heat and flame resistant fibers **201**. Also, the voluminous bulking zone **220** is divided into a first bulking zone **230** and a second bulking zone **240**. The first bulking zone **230** has an outer boundary **231** located adjacent to the heat and flame resistant zone **210** and inner boundary **232** located adjacent to the second bulking zone **240**. The second bulking zone **240** has an outer boundary **241** located adjacent to the outer surface of the shield material **200** and an inner boundary **242** located adjacent to the first bulking zone **230**. As previously stated, the shield material **200** is a unitary material, and as such, the boundaries of the two bulking zones do not represent the delineation of layers, but areas with in the unitary material. Because the shield material **200** is a unitary material, and the first bulking zone **230** and the second bulking zone **240** are not discrete separate layers joined together, various individual bulking fibers will occur in both the first bulking zone and the second bulking zone **240**. Although FIG. **2** illustrates the heat and flame resistant zone **210** being a smaller thickness than the voluminous bulking zone **220**, the relative thickness of the two zones can have a substantially different than as shown.

Still referring to FIG. **2**, the first bulking zone **230** contains both the first bulking fibers **203** and the second bulking fibers **204**. However, the first bulking zone **230** will contain more of the first bulking fibers **203** than the second bulking fibers **204**. The distribution of the fibers in the first bulking zone **230** is such that the concentration of the first bulking fibers **203** increases in a gradient along the z direction from the outer boundary **231** of the first bulking zone **230** to a first bulking fiber concentration plane **235** located between the inner boundary **232** and the outer boundary of the first bulking zone. Also, as illustrated, it is preferred that the concentration of the first bulking fibers **203** decreases in a gradient along the z-axis from the first bulking fiber concentration plane **235** to the inner boundary **232** of that zone.

Referring still to FIG. **2**, the second bulking zone **240** contains both the first bulking fibers **203** and the second bulking fibers **204**. However, the second bulking zone **240** will contain more of the second bulking fibers **204** than the first bulking fibers **203**. The distribution of the fibers in the second bulking zone **230** is such that the concentration of the second bulking fibers **204** is greater at the outer boundary **241** of the second bulking zone **240** than the inner boundary **242** of that zone. Also, as illustrated, it is preferred that the concentration of the second bulking fibers **204** decreases in a gradient along the z-axis from the outer boundary **241** of the second bulking zone **240** to the inner boundary **242** of that zone.

Still referring to FIG. **2**, the first bulking zone **230** will also contain heat and flame resistant fibers **201**. However, the first bulking zone **230** will contain more of the first bulking fibers **203** than the heat and flame resistant fibers **201**. The heat and flame resistant zone **210** can have some amount of the second bulking fiber **204**; however, the amount of second bulking fiber **204** in the heat and flame resistant zone **210** is significantly lower than the first bulking fibers **203**. The second bulking zone **240** can also have some amount of the heat and flame resistant fibers **201**; however, the amount of the heat and flame resistant fibers **201** in the second bulking zone **240**, if any, is significantly lower than the first bulking fibers **203**. An advantage of using the two distinct bulking fibers **203/204** (FIG. **2**) over using a single bulking fiber **102** (FIG. **1**), is that for the same respective weights of heat and flame resistant fibers **101/201** and voluminous bulking fibers **102/202**, a shield material **200** having two types of bulking fibers **203** and **204** will have fewer heat and flame resistant fibers **201** located in the voluminous bulking zone **120/220** than a shield material **100** having only one type of bulking fiber **102**.

Referring now to FIGS. **1** and **2**, it is contemplated that the shield material **100/200** can include additional fibers that create additional zones extending outward from the bulking zone **120/220**. In such embodiments, the outer boundary **121/221/241** of the bulking zone **120/220** will not be adjacent to the exterior of the shield material **100/200**, but will be disposed in the interior of the shield material **100/200**. The additional zones will also have an area of transition in the concentration of the bulking fibers **102/204** to the additional fibers, similar to the transition of the first bulking fibers **203** to the second bulking fibers **204** in the shield material **200**. Multiple additional zones can be created with multiple additional fibers, resulting in many additional zones. In the outer most additional zone, the fibers creating that outer most additional zone will be concentrated at the exterior of the shield material **100/200** similar to the bulking fibers **102** and **204** as shown in FIGS. **1** and **2**.

Referring now to FIG. **3**, there is shown a diagram of a particular piece of equipment **300** for the process to form the planar unitary heat and flame shield from FIGS. **1** and **2**. A commercially available piece of equipment that has been found satisfactory in this process to form the claimed invention is the "K-12 HIGH-LOFT RANDOM CARD" by Fehrer AG, in Linz, Austria. The heat and flame resistant fibers **101/201** and the voluminous bulking fibers **102/202** are opened and blended in the appropriate proportions and enter an air chamber **310**. In an embodiment using the binder fibers **105/205**, the binder fibers **105/205** are also opened and blended with the heat and flame resistant fibers **101/201** and the bulking fibers **102/202** prior to introduction into the air chamber **310**. In an embodiment where the voluminous bulking fibers **202** contain multiple types of bulking fibers **203/204**, those multiple types of bulking fibers **203/204** are also opened and blended in the appropriate portions with the other fibers before introduction into the air chamber **310**. The air chamber **310** suspends the blended fibers in air, and are expelled for delivery to an air lay machine that uses a cylinder **320**. The cylinder **320** rotates and slings the blended fibers towards a collection belt **330**. The spinning rotation of the cylinder **320** slings the heavier fibers a further distance along the collection belt **330** than it slings the lighter fibers. As a result, the mat of fibers collected on the collection belt **330** will have a greater concentration of the lighter fibers adjacent to the collection belt **330**, and a greater concentration of the heavier fibers further away from the collection belt **330**. In general, the larger the difference in denier between the fibers, the greater the gradient will be in the distribution of the fibers.

In the embodiment of the shield **100** illustrated in FIG. **1**, the heat and flame resistant fibers **101** are lighter than the voluminous bulking fibers **102**. Therefore, in the process illustrated in FIG. **3**, the heat and flame resistant fibers **101** collect in greater concentration near the collection belt **330**, and the voluminous bulking fibers **102** collect in greater concentration away from the collection belt **330**. It is this distribution by the equipment **300** that creates the heat and flame resistant zone **110** and the voluminous bulking zone **120** of the planar unitary shield material **100**.

In the embodiment of the shield **200** illustrated in FIG. **2**, the heat and flame resistant fibers **201** are lighter than the voluminous bulking fibers **202**. Therefore, in the process illustrated in FIG. **3**, the heat and flame resistant fibers **201** collect in greater concentration near the collection belt **330**, and the voluminous bulking fibers **202** collect in greater concentration away from the collection belt **330**. It is this distribution by the equipment **300** that creates the heat and flame resistant zone **210** and the voluminous bulking zone **220** of the planar unitary shield material **200**. Additionally, the first bulking fibers **203** of the voluminous bulking fibers **220** are lighter than the second bulking fibers **204**. Therefore, in the process illustrated in FIG. **3**, the first bulking fibers **203** are collected in greater concentration nearer the collection belt **330** than the second bulking fibers **204**. It is this distribution that creates the first bulking zone **230** and the second bulking zone **240** of the voluminous bulking zone **220** of the planar unitary shield material **200**.

In formation of the shield material **100/200**, the combined percentage of heat and flame resistant fibers can range from about 10% by total weight, to about 90% by total weight. The combined percentage of bulking fibers in the shield material **100/200** can range from about 80% by total weight, to about 5% by total weight. An optimum amount of binder fibers in the shield material **100/200** can range from about 10% by total weight to about 40% by total weight. It has been found that a high loft shield material provides a desirable product for quilting with other materials to use in applications such as mattress borders and panels. The combination of bulking fibers with the heat and flame resistant fibers in the present process reduces costs by reducing steps and gives better performance than combining two separate layers of the materials for criteria such as de-lamination. Additionally, the performance of the shield material appears to have better flame resistance for the same cost, and a lower cost for similar performance.

In a first example of the present invention, planar unitary heat and flame resistant shield material was formed from a blend of four fibers including:

1) 4% by weight of a heat and flame resistant fiber being 2 dpf partially oxidized polyacrylonitrile
2) 25% by weight of a first bulking fiber being 6 dpf polyester
3) 41% by weight of a second bulking fiber being 15 dpf polyester, and
4) 30% by weight of a low melt binder fiber being 4 dpf core sheath polyester with a lower melting temperature sheath.

The fibers were opened, blended and formed into a shield material using a "K-12 HIGH-LOFT RANDOM CARD" by Fehrer AG. The shield had a weight per square yard of about 16-32 ounces and a thickness in the range of about 12-37 mm. In the resulting shield material, the heat and flame resistant fibers in the heat and flame resistant zone comprised at least 70% of the total fibers in that zone, and the heat and flame resistant fibers in the voluminous bulking zone were less than about 2% of the total fibers in that zone.

In a second example of the present invention, planar unitary heat and flame resistant shield material was formed from a blend of four fibers including:

1) 40% by weight of a heat and flame resistant fiber being about 3.2 dpf Visil®
2) 20% by weight of about 2 dpf modacrylic (Kanecaron™)
3) 20% by weight of a bulking fiber being 15 dpf polyester, and
4) 20% by weight of a low melt binder fiber being 4 dpf core sheath polyester with a lower melting temperature sheath.

The fibers were opened, blended and formed into a shield material using the "K-12 HIGH-LOFT RANDOM CARD" by Fehrer AG. The shield had a weight per square yard of about 8 ounces and a thickness in the range of about 25 mm. In the resulting shield material, the heat and flame resistant fibers in the heat and flame resistant zone comprised at least 60% of the total fibers in that zone, and the heat and flame resistant fibers in the voluminous bulking zone were less than about 40% of the total fibers in that zone. In an alternate version of the second example, the low melt binder fiber was a 10 dpf core sheath polyester with a lower melting temperature sheath.

In a third example of the present invention, planar unitary heat and flame resistant shield material was formed from a blend of four fibers including:

1) 30% by weight of a heat and flame resistant fiber being about 3.2 dpf Visil®
2) 30% by weight of about 2 dpf modacrylic (Kanecaron™)
3) 20% by weight of a bulking fiber being 15 dpf polyester, and
4) 20% by weight of a low melt binder fiber being 4 dpf core sheath polyester with a lower melting temperature sheath.

The fibers were opened, blended and formed into a shield material using the "K-12 HIGH-LOFT RANDOM CARD" by Fehrer AG. The shield had a weight per square yard of about 8 ounces and a thickness in the range of about 25 mm. In the resulting shield material, the heat and flame resistant fibers in the heat and flame resistant zone comprised at least 60% of the total fibers in that zone, and the heat and flame resistant fibers in the voluminous bulking zone were less than about 40% of the total fibers in that zone.

In a fourth example of the present invention, planar unitary heat and flame resistant shield material was formed from a blend of four fibers including:

1) 40% by weight of a heat and flame resistant fiber being about 3.2 dpf Visil®
2) 40% by weight of about 2 dpf modacrylic (Kanecaron™)
3) 15% by weight of a bulking fiber being 15 dpf polyester, and
4) 5% by weight of a low melt binder fiber being 4 dpf core sheath polyester with a lower melting temperature sheath.

The fibers were opened, blended and formed into a shield material using the "K-12 HIGH-LOFT RANDOM CARD" by Fehrer AG. The shield had a weight per square yard of about 10 ounces and a thickness in the range of about 25 mm. In the resulting shield material, the heat and flame resistant fibers in the heat and flame resistant zone comprised at least 60% of the total fibers in that zone, and the heat and flame resistant fibers in the voluminous bulking zone were less than about 40% of the total fibers in that zone.

In a fifth example of the present invention, planar unitary heat and flame resistant shield material was formed from a blend of four fibers including:

1) 50% by weight of a heat and flame resistant fiber being 2 dpf panox
2) 30% by weight of a bulking fiber being 15 dpf polyester, and
4) 20% by weight of a low melt binder fiber being 4 dpf core sheath polyester with a lower melting temperature sheath.

The fibers were opened, blended and formed into a shield material using the "K-12 HIGH-LOFT RANDOM CARD" by Fehrer AG. The shield had a weight per square yard of about 6 ounces and a thickness in the range of about 25 mm. In the resulting shield material, the heat and flame resistant fibers in the heat and flame resistant zone comprised at least 60% of the total fibers in that zone, and the heat and flame resistant fibers in the voluminous bulking zone were less than about 40% of the total fibers in that zone.

Referring now to FIG. **4**, there is shown an enlarged cross sectional view of an embodiment of the shield material **100** from FIG. **1** formed according to the method disclosed with reference to FIG. **3**. FIG. **4** illustrates the heat and flame resistant zone above the bulking zone. As can be seen, the fibers have an orientation with the mode of the angle being at approximately 30 degrees, which is most pronounced in the bulking zone. The angle of the fibers are a result of the manufacturing process, and give the shield material a stiffness and resiliency. The mode of the angle for the fibers can vary from about 5 degrees to about 80 degrees towards the horizontal z-direction from the planar dimensions of the shield material **100**.

Referring now to FIG. **5**, there is shown a mattress incorporating the shield material **100/200**. The mattress **500** includes a first side **511**, an opposing second side **512**, and at least one of side walls **521**, **522**, **523**, and **524** connecting the first side **511** and the second side **512**. Illustrated in FIG. **6** is a partial cutaway view of a wall **600** used for the sides **511**, **512**, or walls **521**, **522**, **523**, and **524** of the mattress **500** in FIG. **5**. As illustrated, the wall **600** includes an exterior ticking material **610**, a shield material **620**, a support material **630**, and a backing material **640**. The shield material **100/200** described above in reference to FIGS. **1-4**, can be used as the shield material **620** in the wall **600** and is preferably oriented with the heat and flame resistant zone nearest to the exterior ticking material **610**. The support material **630** is a resilient material such as foam, nonwoven, or the like. The backing material **640** is a flexible material such as a woven, knitted, or nonwoven textile.

Although the present invention has been described in considerable detail with reference to certain preferred versions thereof, other versions are possible. For example, an additional layer of material such as a nonwoven can be added to the outside surface or the inside surface of the present invention for additional purposes. Therefore, the spirit and scope of the appended claims should not be limited to the description of the preferred versions contained herein.

What is claimed is:

1. A method of forming a shield material comprising the steps of blending a plurality of heat and flame resistant fibers having a first denier with a plurality of bulking fibers having a second denier being greater than the first denier of the heat and flame resistant fibers and a plurality of binder fibers, and projecting the blended heat and flame resistant fibers, binder fibers, and the bulking fibers along a moving belt such that a unitary nonwoven material is formed on the belt with a heat and flame resistance zone and a bulking zone, whereby the heat and flame resistance zone includes a greater percentage of the heat and flame resistant fibers than the bulking fibers and the bulking zone includes a greater percentage of the bulking fibers than the heat and flame resistant fibers.

2. The method according to claim **1**, wherein the step of blending fibers includes the bulking fibers comprising a first bulking fiber and a second bulking fiber, the second bulking fiber having a greater denier than the first bulking fiber.

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